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Research Article

BIOINSECTICIDAL ACTIVITY OF *JUSTICIA ADATHODA* AGAINST TWO INSECTS *RHIPICEPHALUS MICROPLUS* (TICKS) AND *COPTOTERMES HEIMI* (TERMITES)

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ABSTRACT
In the study an investigation was made to study the insecticidal effect of *Justicia adathoda* against two adult insects Ticks and Termites. This initial study has shown that the ethanolic extract of the leaves of this plant does have a good potential for use against these two insect pests. The crude extract has shown mortality percentages of 70% in the case of Ticks and 90% in the case of Termites after exposure to 1000 ppm of the extract for 48 hours further studies with the purified extract can be carried out as a part of future investigation.

Keywords: *of Justicia Adathoda, Insecticidal, Ticks and Termites*

INTRODUCTION
From a purely human centric standpoint, insects are pests when they harm man, his crops, animals or property. More specifically, an insect is classified as a pest if the damage it causes to a crop or to livestock is sufficient to reduce the yield and/or quality of the harvested product, to property or the human self by an amount that is unacceptable to the current economic situation (Dent, 1991). Insects damage crops, furniture and other useful articles in many different ways; however the haemophagus insects which feed on the blood of animals and human beings are a cause of concern because they feed on blood and in addition to this also act as vectors of diseases. Insect-transmitted diseases remain a major cause of illness and death worldwide both in livestock and human beings (Schardl and Chen, 2010). Vector and vector-borne diseases have become a challenging problem to the health of both man and animals as it has social and economical impact especially in subtropical and tropical countries (Wei *et al.,* 2007).

The increasing political and consumer pressures to reduce the usage of synthetic insecticides due to their adverse environmental effects, residues on agricultural products and uncertain long-term ecological and biological effects (Isman 2000). This combined with the decreasing efficacy of synthetic insecticides due to the development of resistance (Ahn *et al.,* 1997) has once again turned the attention of scientists towards plant based insecticides. Natural products from plants are alternative sources of insect control agents since they contain a range of bioactive chemicals, which are selective and do not harm non-target organisms and the environment (Subramaniam and Sandeep, 2014).

Plants have formed the basis of natural pesticides that make excellent leads for new pesticide development. The progress in our search for plant based insecticides not withstanding a majority of the population especially in the third world countries still uses chemical insecticides. The major reason for this is probably the wide spectrum of insects against which a chemical insecticide generally acts whereas most natural insecticides act against a narrow range of target insects. The search for identifying a general purpose natural insecticide is therefore continuing. In the present study we have tried to test the bio efficacy of different extracts of *Justicia adhatoda* (L) a plant belonging to family Acanthaceae against two insects tick (*Rhipicephalus microplus*) and Termites (*Coptotermes heimi*). The plant which contains a known alkaloid vasicine is extensively used in the traditional systems of medicine systems like Ayurveda, Siddha and Unani. The bitter alkaloid extracted from this plant is known to be beneficial in respiratory problems like asthma and cough, however no studies related to the possible insecticidal activity of this plant have made so far.

Figure: 1

MATERIALS AND METHODS

A.) Plant Material

Botanical Name: *Adhatoda vasica* Nees
Adhatoda zeylanica Medic.
Family: Acanthaceae.
Local Name: Baikar basuti, Vasaka.

Description: An erect much branched, gregarious, evergreen shrub, up to 2 (-2.5) m. Stem ± quadrangular to nearly terete, young shoots greyish-pubescent Leaves with (1-) 1.5-3.5 (-4.5) cm long petioles; lamina elliptic-lanceolate, 10-20 x 3.5-8 cm, glabrous above, pubescent on nerves beneath, basally attenuate, entire, acuinate. Flowers white, c. 3 cm long, nearly sessile, in terminal and axillary spikes, up to 10 cm long, 2.5-3 cm broad; bracts leafy, broadly-elliptic, 1.5-2.5 x (0.8) 1-1.5 (-1.8) cm, pubescent; bracteoles elliptic-oblong to lanceolate, 1-1.5 (-2) x 0.3-0.5 cm, acute, minutely pubescent. Calyx 5-lobed, lobes linear-lanceolate, 6-10 x c. 2 mm, acute, puberulous, imbricate. Corolla pale-white, tube 1.2-1.5 cm long, pubescent outside, throat villous, limb 2-lipped, upper lip erect, shortly bifid, galeate, lower lip with 3 elliptic, obtuse lobes. Stamens 2, filaments 1-1.5 cm long, anthers oblong, basally apiculate. Ovary oblong, c. 3 mm long, style 2-2.5 cm long. Capsule stipitate, broadly clavate, c. 2.5 cm long, 4-seeded, pubescent. Seeds ± orbicular, 2-3 mm across, glabrous. Fl. Per.: November-April (plains); July-October (hills). Distribution: Panama (probably) introduced), Indonesia, Malaya, S.E. Asia, India and Pakistan.up to 1300 m (Toki *et al.*, 2008).

Figure 2

B) Target Insects

I. **Scientific Name***: Rhipicephalus microplus* Canestrini

(syn. *Boophilus microplus*).
Phylum: Arthropoda**. Family**: Ixodidae.
Common/local name: Tick; Pissu.
Description*: Rhipicephalus microplus* is considered to be the most important tick parasite of livestock in the world.It is a hard tick that can be found on many hosts including cattle, buffalo, horses, donkeys, goats, sheep, deer, pigs, dogs and some wild animals. Heavy tick burdens on animals can decrease production of milk and may damage hides. *R. microplus* can also transmit babesiosis (caused by the protozoal parasites *Babesia bigemina* and *Babesia bovis*) and anaplasmosis (caused by *Anaplasma marginale*). Under experimental conditions, this tick can transmit *Babesia equi*, the cause of equine piroplasmosis.
Distribution: *B. microplus* is found worldwide in subtropical and tropical regions. This tick is endemic in the Indian region, much of tropical and subtropical Asia, North-eastern Australia, Madagascar, South-eastern Africa, the Caribbean, and many countries in South and Central America and Mexico (Johnson and Wade, 2013).
3. *Coptotermes heimi* Wasmann.
Phylum: Arthropoda**. Family**: Rhinotermitidae
Common/local name: Termite (Eng); Seonk, Deemak

Figure: 3

Description: The insect is found worldwide in all the continents and is a serious pest of wood and wooden products. Termites are generally grouped according to their feeding behavior. Thus, the commonly used general groupings are subterranean, soil-feeding, drywood, dampwood, and grass-eating. Of these, subterraneans and drywoods are primarily responsible for damage to human-made structures (Su, 2003).

MATERIALS AND METHODS

Methods

Preparation of crude extract: The powdered plant part was heated with one polar (ethanol) and one non-polar (hexane) solvent so that the active principle dissolved completely in these solvents. Ethanol and hexane were used as the primary solvents.The extracts were prepared from each plant part – stem, root, leaf, and flower seperately. After making the extract, the respective solvents were dried out in vacuum to give a solid crude extract. During this process, temperature was maintained at a level (below 50 c) which does not harm the active principle dissolved in the solvents. A special high dosageof 2000ppm of each plant part was prepared in the two solvents and tested against the two target insects. The part whose extract gave the best results was further tested against the insects by expoasing the insects to different doses of the plant extract Different dosages of solution of the crude extracts were prepared using an emulsifying agent (Tween) and acetone / water as the solvent in concentrations of 100 ppm to 500 ppm.These dosages ranging from 100-1000 ppm were administered to the target insects to check their broad efficacy using standard procedures and precautions. The extracts were administered in triplicates and the average of all three readings was taken as the mortality. The readings were taken after 24 h and 48 h of administering the extracts to the target insects.
Ticks (*Rhipicephalus macroplus*) (methodology of Prates, 1998):
Ticks were collected from one broad side of a cow or buffalo and stored in a bottle. One liter of the crude extract of the plant made in Acetone / water: tween mixture was immediately sprayed on the broad side

of the animal from which the ticks' were counted. Ten stored ticks were then released on to the broad side sprayed with extract. A count of dead ticks was then made after 12 h and 24 h respectively.

3.Termites (*Coptotermes _heimi*) (methodology of Spikkett, 2002):

Termites were collected from the field and stored at 20 c. 100 gms of mud containing twigs and dried leaf parts was spread in Petri dishes and 10ml of the crude extract of the plant selected made in : Acetone/water mixture was poured into this and mixed properly. Ten termites were then released into this dish, which was subsequently covered by another Petri dish for 12 h and 24 h .After the stipulated time, the number of dead termites were counted.

RESULTS AND DISCUSSION

Results

The initial tests with the different parts of the plant showed that the Hexane extracts of all the four parts that is the stem, root, leaf and flower wre not very effectivein killing the target insects and the mortality percentage for the stem extract (Table2) was 10% at 200ppm for termites and 20% for ticks at the same concentration.

The moratlity percentage remained the same even after 48 hours of exposure. Similarly the mortality percentage for termits and ticks when exposed to 2000 ppm of hexane leaf extract was 10% and 20% respectively after 12h, 24h, 36h and 48h of exposure. The results with the hexane extracts of the root and flower of *J. adathoda* showed a mortality percentage of 10% in both the cases after the maximum period of 48 hours. In view of the above results it was decided to concentrate on the ethanolic extract of theplant for further insecticidal investigations.

The 2000 ppm ethanol extract of the stem casued a mortality of 10% and 20% in termites and ticks (Table1) after 12 hours, and after 48 h the mortality was 40% in both termites and ticks.

Table 1: Mortality percentage of target insects exposed to 2000 ppm of the ethanol extract

Plant part used	Mortality percentage After 12 hours		Mortalitypercentage After 24 hours		Mortalitypercentage After 36 hours		Mortalitypercentage After 48 hours	
	Termites	Ticks	Termites	Ticks	Termites	Ticks	Termites	Ticks
Stem	10	20	10	20	10	20	10	20
Leaves	10	20	20	20	20	20	20	20
Roots	10	10	10	10	10	10	10	10
Flower	10	10	10	10	10	10	10	10

Table 2: Mortality percentage of termites &ticks exposed to 2000 ppm concentration of haxene extract of justicia adathoda

Plant part used	Mortality percentage After 12 hours		Mortalitypercentage After 24 hours		Mortalitypercentage After 36 hours		Mortalitypercentage After 48 hours	
	Termites	Ticks	Termites	Ticks	Termites	Ticks	Termites	Ticks
Stem	10	20	30	30	40	40	40	40
Leaves	20	40	50	60	90	70	90	70
Roots	10	10	30	30	30	50	30	50
Flower	10	20	10	20	20	40	20	40

Table 3: Effect of different concentrations of crude ethanolic leaf extract on the two target insects (termites and ticks)

Name of target insect	Mortality(%age)of insects in different concentration of crude Ethanolic Leaf extract											
	100 ppm		200 ppm		400ppm		600ppm		800ppm		1000ppm	
	After 24 h	After 48 h	After 24 h	After 48 h	After 24 h	After 48 h	After 24 h	After 48 h	After 24 h	After 48 h	After 24 h	After 48 h
Ticks	0	0	10	10	30	40	30	60	60	60	60	70
Termites	0	0	40	40	60	60	60	60	60	60	60	90

The leaf extract of the plant at 2000 ppm showed a mortality percentage of 40% in the case of termites and 20% in the case of Ticks after an exposure of 12 hours, this mortality increased to 60% and 50% respectively after 24h and after 48h the mortality percentage was 90% in the case of termites and 70% in the case of ticks. The results with the root extract were 10%mortalityin both termites and ticks after 12h and 30% mortality for termites for the remainigtg period, this mortality was 50% for the remaining period in ticks The 2000 ppm flower extract gave an initial mortality of 105 and 20% for termites and ticks respectively after 12h which increased to 20% and 40% respectively after 48h. The best results againstboth theinsects were shown by the leaf extract of the plant therefore it was decided that the further studies were conduted using only the ethanolic leaf extract of *J.adathoda* The leaf extract of J. adathoda was prepared using ethanol as the primary solvent and different concentrations of this extract were prepared. These concentrations of 100ppm, 200ppm, 400ppm, 600ppm, 800ppm and 1000ppm were used against the two target insects to check the mortality of the insects against the extracts (Table3). The mortality percentage for 100ppm after 24h exposure was nil in both the insects andremained the same even after 48h of exposure, on exposure to 200ppm concentration the mortality percentage was 40% in termites and 10% in ticks after 24h and 48h. The mortality percentage in termites increased to 60% when exposed to 400ppm extract and to 30% in the case of ticks after 24h which went upto 40%after 24h. It remained at 60% in the case of termites in 600ppm,and 800ppm. At 1000ppm concentration the mortality was 60% after 24h but increased to 90% after 48hours. In the case of ticks the mortality percentage was 60% in the concentrations 600ppm, 800ppm and 1000ppm except that it incresed to 70% in the 1000ppm after 48hours of exposure.

Discussion

Insect pests play a major role in damaging the agricultural crops and the crop loss varies between 10% and 30% for major crops (Ferry *et al.,* 2004). Plant derived chemicals offer a more natural and environmentally friendly approach to pest control than synthetic insecticides. India is basically an agro-based country more than 80% of population depends on agriculture and Indian economy is largely determined by agricultural productivity. The intensification of agriculture to fulfill food needs has increased the number of insect pest species attacking different crops and as a result the annual production losses of the standing crops. In the past decade, pesticides have played a major role in agriculture crop protection programmes and have enormously benefited mankind. Nevertheless, their indiscriminate use has resulted in the development of resistance by pests (insects, weeds, etc), resurgence and outbreak of new pests, toxicity to non-target organisms and hazardous effects on the environment endangering the sustainability of ecosystems (Jeyasankar and Jesudasan, 2005). Among current alternative strategies aiming at decreasing or minimizing the use of chemical insecticides, eco-chemical control based on plant-insect relationships is one of the most promising methods (Jeyasankar *et al.,* 2014). In this current scenario the present study was made to check the insecticidal activity of the plant *Justicia adathoda* against two adult insects Ticks and Termites. This initial study has shown that the ethanolic extract of the leaves of this plant does have a good potential for use against these two insect pests. The crude extract has shown mortality percentages of 70% in the case of Ticks and 90% in the case of Termites fter exposure

to 1000 ppm of the extract for 48 hours further studies with the purified extract can be carried out as a part of future investigation.

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